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TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

No. 104

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No. 104

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BRIEFS

SATELLITE LINK--The Andaman and Nicobar Islands have been linked by satellite communication system. The channels between Car Nicobar and Madras became operational today.--UNI [Text] [Calcutta THE STATESMAN in English 15 Dec 79 p 9]

CSO: 5500

BRIEFS

RS. 3 CRORE SET FOR TELECOMMUNICATIONS--Faisalabad, Dec 28--
The Government would spend Rs 35 crore on improving and modernising telecommunications in the country, the Director-General, Pakistan Telegraph and Telephones, Mr S.A. Siddiqi said here yesterday. Speaking at the Chamber of Commerce and Industry, he said that consumers would be given 10,000 new connections this year. He said two new automatic telephone exchanges were under construction and on completion 3,500 new connections could be given in the city. He said the capacity of the telex system in the city would also be enhanced from 20 to 100 lines. He said the Telephones Department could build more exchanges in the city provided enough land was available. The Chambers of Commerce and Industry assured the Director-General that the Chamber would procure land for the purpose.--APP. [Text] [Karachi MORNING NEWS in English 29 Dec 79 p 3]

CSO: 5500

PEOPLE'S REPUBLIC OF CHINA

BRIEFS

SHANGHAI TELEPHONE SERVICE--Shanghai, 15 Dec--The Shanghai telephone bureau has recently installed a memory storage magnetic disc device to provide Shanghai's citizens with telephone numbers upon inquiry. Correct numbers will be given within 3 seconds. Manufactured by the Shanghai electric instrument factory, this device is able to store more than 100,000 telephone numbers in its memory bank. [Beijing XINHUA Domestic Service in Chinese 0118 GMT 15 Dec 79 OW]

SHANGHAI COMPUTERIZED TELEGRAPHIC EQUIPMENT--Shanghai, 7 Dec--As a result of installing computerized automatic transmitting equipment at the Shanghai telegraph office, time needed for transmitting telegrams from Shanghai to 15 cities has been reduced from 38 minutes in the past to 3 minutes at present. Since the installation of this equipment in late July, this office has transmitted some 650,000 telegrams in 3 months or so without any mistakes in transmission. The equipment was installed with the assistance of the Shanghai No 13 radio plant and Fudan university. [Beijing XINHUA Domestic Service in Chinese 0113 GMT 7 Dec 79 OW]

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REPORTAGE ON MODERN TECHNOLOGY IN COMMUNICATIONS, CONTRACTS

Advances in Telecommunications Reviewed

Buenos Aires LA PRENSA in Spanish 29 Oct 79 p 10 sec 1

[Interview with Brig Gen Eduardo O Corrado, secretary of communications, by LA PRENSA; date and place not given]

[Text] Brig Gen Eduardo O Corrado, secretary of communications, told us during an interview, "Bids are now being accepted for electronic central automatic telephone exchanges for 550,000 subscribers in Argentina. Bids are also being accepted for electronic central traffic light controls for traffic in the city of Buenos Aires and for traffic to and from the suburbs or between them, a project called "Buenos Aires digital belt."

The conversation was as follows:

[Question] In the same way that a "government-to-government" loan from Spain was arranged for the acquisition of communications equipment, is there any prospect of similar arrangements being made with other countries?

[Answer] Although no government-to-government loans for telecommunications material, similar to the one worked out with Spain, are at present being considered, there is always the possibility of making similar arrangements with other countries when the terms of the bids are advantageous to us.

[Question] What is your opinion of the World Radiocommunications Administrative Conference (CAMR) which is taking place in Geneva?

[Answer] The Argentine delegation to CAMR which has been taking place in Geneva since 24 September 1979 is headed by Roberto Severini, deputy technical secretary of the State Communications Secretariat.

It is worth mentioning that after 4 days of deliberations our country was unanimously elected to fill the presidency of that world conference, this very important post falling to Roberto Severini.

The meeting called by the International Union of Telecommunications [UIT] has as its objective to review, harmonize and bring up to date international regulations applicable to all radiocommunication services subscribed to by the 154 member nations of UIT.

The agreement is complemented by administrative regulations which govern the use of telecommunications and which relate to frequency spectra assigned to telephone, telegraph and radiocommunications. The latter deals with the use of the radio spectrum; that is, the assignment of frequency bands for earth surface and satellite services and the conditions under which the services involved can be used.

The previous gathering was in 1959, that meeting also being held in Geneva. Since that time important matters relative to telecommunications have been dealt with in specialized conferences. The main services of telecommunications are as follows: space, mobile aeronautical, mobile maritime, voice radio and television broadcast and direct voice broadcasting via satellite.

It is very important to emphasize that the regulations to be reviewed by the conference which is now taking place (CAMR 79) will be of use for all the UIT member nations and will influence world development of telecommunications until the end of this century when they will once again be reviewed.

[Question] You stated recently that a trilogy exists consisting of electronics as technology, the information service as a processor of information and telecommunications as a means of transmitting that information... What is Argentina's situation in regard to this process?

[Answer] There is no doubt that in our time there has been a technological advance typified by electronics. It can be said that there is no activity which is not influenced directly or indirectly by it.

The advances made in the field of components, especially semiconductors, have doubtless contributed to its rapid and continuous evolution.

Communications, a fundamental element of human activity, have acquired a new dimension as a result of electronics. Profound changes are also driving electronics forward. It is now possible to handle a large quantity of information in a quick and sure way. Digital techniques are no longer unique to computers. They are being used more and more and they tend to take in the entire telecommunications field.

Equipment is significantly reduced in size and costs become lower. Within broad limits the information contained within different systems can be determined at will. The capacity for processing varies, then, from that of a microprocessor made up of a single circuit designed for one or a few functions, all the way up to computers capable of carrying out tasks of astonishing number and complexity.

Finally, transmission systems; advances have not been insignificant in this field. The mere mention of geostationary satellites, which make possible high capacitance hookups for any service not only at the international but also at a national level, makes further comment unnecessary.

Our country plans to solve the problems of its communications infrastructure by adopting the newest technology, modern methods of processing information and transmission systems adapted to them. Examples in some of the services are as follows:

Telephone Service

The more advanced countries have started using electronic central exchanges. This new technology, which will gradually replace the methods now in general use by an electromechanical one, allows for the processing of information at levels of speed and in amounts which already have been noticeable in their effect on service. The fact is that this new type of central exchange performs functions which previously could only be performed by a person or were simply not performed. Now maintenance has a high degree of automation and in addition provides such service as billing, routing, priority calls, shorter dialing, automatic repeaters, multiparty calls, automatic alarm clock, transfer of calls and others which are made possible by the new technology and which the processor makes use of.

This is already beginning to be done in our country.

Bids are now being accepted for electronic central automatic telephone exchanges for 550,000 subscribers in Argentina. Bids are also being accepted for electronic central traffic light controls for traffic in the city of Buenos Aires and for traffic to and from the suburbs or between them, a project called "Buenos Aires digital belt."

In addition, regarding the Intercity Automatic Telephone Exchanges which make possible national long distance dialing, seven of them are already installed with electronic equipment with a total of 6,575 lines and with plans for expansion to 23,000 new lines by 1983.

Telegraphy

Electronic technology has also penetrated telegraphy but in such a manner that there are serious difficulties in defining and differentiating between services and means of transmission. What is true is that advances are appearing very rapidly so that there isn't time to enumerate individually the new services which keep appearing.

The usefulness of these in existence is open to question. Digital techniques are responsible for exceptional advances and also for the prevailing confusion.

In making the classification outlined below I am taking a risk which is necessary to put things in order:

Electronic Message Service: all services under this name originated from telegraphy.

They are the ones which are used for the transmission of messages sent by the customer, or by the personnel who accepts them at windows of public telegraph offices or through a data center or bank. In going forward, the message will make use of electronic processors which will, by automatic communtation, establish routes and rates and perform other auxiliary tasks and will be received by the customer directly or through a public telegraph office with distribution by messenger service.

This very general concept includes the following services:

--Telex service: it is a service already widely distributed in which the subscriber transmits and receives directly using a teleprinter machine.

--Public telegraph service: this is the one which is perhaps the oldest of all in which the sender is the general public and for which home delivery of the message is provided.

--Teletex service: a new service now being developed for the interchange of written texts and correspondence between offices using special typewriters. At first it will be sent through the telex network. It has not yet been distributed or organized.

According to some forecasts it would replace an important part of postal traffic.

--Videotex service: this is another service being developed. It will connect subscribers with a data bank. The subscriber uses a terminal which will include a television set.

It can be "broadcast videotex" (in which case it will not go through an exchange) if the information comes through the signal of a normal television channel or "interactive videotex" if it relies, for example, on the telephone network. In the first case, communication is one-way from the data bank to the subscriber (weather, movies, theater, stock exchange, prices in general and so forth) and in the second is two-way (for professional subscribers, specific groups, government bodies or the general public) which can rely on the public network. This service has been neither distributed nor organized.

Facsimile Service

Although the service has been known for some time, it is only now starting to have an important application. However, it has not gone beyond the stage of organization, especially at the international level, which will determine its large-scale use. It provides, as is already known, direct transmission between subscribers of written messages, drawings, still pictures and so forth. It relies primarily on the telephone network. Without doubt its development will affect telex traffic.

Electronic Postal Service

It will use the same system as the facsimile system, but in this case the sender is the general public, reception will be made in a public telegraph office and distribution will be made by messenger.

The influence which the development of this service will have on postal and telegraph traffic is not possible to predict with exactness but it will without doubt be very important.

The Telex Network

Argentina has a telex network with approximately 5,000 lines which is already using electronic exchanges which provide automatic operation at the national and international levels.

Its expansion, which has already been planned, is the reason for continuous studies for the development of other services.

For the purpose of modernizing the public telegraph service, bids were invited for the Automatic Transmission of Messages System which uses the new technology, with its high computation capacity for the storage and retransmission of information. Transmission at high speed will be possible and it will be automated and commutated. The system provides 350 telex terminal offices in the whole country.

The facsimile service and the electronic postal service were set up on an experimental basis. Rate regulations and technical specifications will soon be decided upon. In any event, an example already exists in the Buenos Aires-Cordoba electronic postal service, in which the first trial runs are being conducted.

Finally, to mention the data system which is being developed based on the telephone infrastructure, the customer himself operating the terminal.

The principle subscribers belong to the commercial, industrial, banking and finance areas and that, in addition to the requirements for service to the public, has brought about the plan for a national network for data transmission which will enable us, on a single network, to get the maximum benefit for all electronic message services.

Transmission Systems

The world tendency points toward two clearly defined objectives: capacity and speed.

All the services mentioned above will be provided through the use of transmission networks of this type.

Furthermore, arrangements are being made so that by means of one single net it will be possible to transmit the broadcasts of all the services.

Therefore, there is also a tendency toward "integrated nets" using digital techniques which, moreover, can make possible the capacity and speed which will make the system efficient.

And this is not for commercial use alone. It is also being thought of for use in homes.

At present, support is being provided by land-based and satellite radio links. With regard to the former, great technological hopes are pinned on the optical fiber which is the application of the laser beam which has a wide band for large capacity. The latest microwaves and coaxial cables are being installed in systems using digital technology.

For example, it is possible to point out that in the case of microwaves the 20 GHz is already being used, which makes it possible to carry 5,760 telephone channels.

However, experiments are continuing to be made using frequencies of over 40 GHz.

Regarding coaxial cables, the level of development is similar to that of the preceding case. Equivalent capacities are being achieved through the use of PCM (encoded pulsation modulation).

But perhaps the most unimpeded progress is based on the use of communications satellites.

Its use for international traffic is known.

Technology makes possible its use at a national level.

There are countries that already own such a system. It can be said that its development is held back principally by the problem of cost.

In any event, the idea of integrated nets is completed by the concept of alternatives, that is, of owning a primary integrated net and a secondary integrated net.

Satellite Experts

The Argentine telecommunications infrastructure consists of a network of microwave radio and coaxial cable hookups. It is in the process of being developed to the point where it will be increased on a medium-range basis from 1.8 million km of circuits to 8 million km of circuits.

With regard to the introduction of optical fiber into our transmission network system, it should be point out that plans call for the experimental installation of a hookup of this type to link the central telephone exchanges of Burzaco and Adrogue.

In addition, successful experiments have already been performed using PCM, Fabricaciones Militares being responsible for the production of terminals to satisfy the national demand.

Finally, the new satellite technology is being studied and ENTEL has made arrangements for the installation in 1981-82 in Argentina of the first ground stations for domestic use using transponders rented by Intelsat.

Telegraph Network Automated

Buenos Aires LA NACION in Spanish 9 Nov 79 p 16

[Text] Col Silvio C Yorio, general manager of the National Mail and Telegraph Enterprise [ENCOTEL], announced that within 2 years the automated national telegraph network will be in operation with centralized equipment in 32 cities of the country and with connections with the rest of the world at a cost of $12 million.

He made these statements after signing a contract with the Siemens firm for the supply, installation and putting into operation of the Message Exchange Center for the network of the Automatic Message Transmission System [SITRAM] at a cost of DM 9,967,379 and 5,596,640,296 pesos.

At the same time, he signed another contract with Equitel, S A for the supply of 1,050 electronic printers at a cost of DM 5,458,330 for the ENCOTEL trunk network, which consists of 400 public offices throughout the country.

Colonel Yorio said that, "this means for us the realization of the most advanced telegraph system in the world." He added that next year the firm will begin the next stage which will involve the modernization of the postal system, leaving for last the improvement of related services such as financial services and money orders.

Bahia Blanca Telephone Service Expanded

Buenos Aires LA NACION in Spanish 7 Nov 79 p 18

[Text] The National Telecommunications Enterprise [ENTEL] will put into service day after tomorrow in Bahia Blanca a modern exchange with 5,000 telephone lines, with automatic timing of service and direct dialing for the entire country.

It is installed in the building at 54 Beruti St where there are already in service 20,000 lines of automatic equipment though there is room ultimately for 70,000 lines for subscribers and 1,300 public phones.

This project is the first of its size in the country installed under the system of financial cooperation. In accordance with the contract signed with ENTEL, the corporation which unites commerce and industry in Bahia Blanca made donations. When operations begin, 3,200 customers will receive service; by the end of the year there will be 4,200 and the rest of the lines will be connected next year when the work on the external distribution net will be completed.

The units about to be entered into service have meant an investment of more than 4,383,000,000 pesos; ENTEL's plans for 1982 provide for the installation of the fourth and fifth telephone units in Bahia Blanca with a total of 15,000 new lines.

The local number of new units will be four and customers' numbers will be 0000 to 4999. Its connection to the interurban automatic exchange of the city will permit new customers to dial direct--using the number 091--to more than 100 places throughout the country.

Telephone Equipment Contract Approved

Buenos Aires LA PRENSA in Spanish 2 Nov 79 p 11

[Text] The president has approved the contract signed between the ENTEL enterprise and the Spanish firm, Standard Electric, S A, for the supply, installation and putting into operation of 90 lines of automatic telephone exchange equipment.

The decree, No 2732, also approves another contract signed by the two firms for the installation of an additional 21,000 lines.

The provisions of the measure state that all the new equipment is assigned to the following exchanges:

For the Arijon exchange, 20,000 lines; 10,000 each for the Alvarex Thomas, Alta Cordoba, Fisherton, Playa Grande, San Vicente, Jonte, Posadas, and Rafaela exchanges; and 1,000 for the Ituzaingo exchange.

In addition, it specifies that according to the agreement the installation of the lines will be carried out in 1980 and 1981, with the exception of the equipment for the San Vicente exchange which will be postponed until the first quarter of 1982.

Some Stations May Go Commercial

Buenos Aires LA NACION in Spanish 8 Nov 79 p 6

[Text] Cordoba--Gen Eduardo Oscar Corrado, national secretary of communications, before ending a 2-day visit to this city said in a press conference, in talking about the future law on radio broadcasting, that it is basically oriented toward "regulating basic aspects of this important activity in the whole country as well as toward determining whether any of the broadcasting stations which constitute the official network can become commercial."

The official indicated that certain stations will become privately owned but that in each province an official radio station will be maintained. "In any event," he added, "those broadcasting stations which are not profitable, such as those on the border, will remain in the hands of the government until they can be placed in private hands." In the specific case of the city of Cordoba, he considered it feasible to have three of the four stations become privately owned, the Radio Nacional local station consequently being excluded.

9204
CSO: 5500

SANTA CRUZ COMMUNICATIONS NETWORK DETAILED

Provincial Communications Head Comments

Buenos Aires LA PRENSA in Spanish 23 Dec 79 p 9

[Text] On the occasion of the publication of this special report, we also conversed with the provincial director of communications of Santa Cruz Province, engineer Carlos Cesar Miculicich.

[Question] How does the communications system for which you are responsible operate?

[Answer] The communications system is comprised of the capital of Rio Gallegos and 14 stations, one for each municipality, and development committees. The equipment consists of BLU transceivers provided with six exclusive frequencies. The service is supplied for official government communications, but this does not mean that, in the case of an emergency, the system could not be used by private individuals.

This system fills a gap in the exchange of the government's function between the provincial executive authority and the municipalities, in view of the lack of telephone communications between several sections of Santa Cruz territory and Rio Gallegos.

The system operates 24 hours a day, 365 days of the year, and affords not only the sending of messages, but also radio conversations. In this way, with a simple system, we have ameliorated a rather serious situation created by the lack of contact or the delayed contact between each municipality and the provincial government.

[Question] What tasks are incumbent on your administration?

[Answer] The Santa Cruz Communications Administration is responsible for all matters associated with government communications. It collaborates technically with the TV channel and all the repeaters, and it is the control agency for the use of the radio frequency spectrum throughout the entire province.

subsidiary of National Radio, in the locality of the same name, and UL 21, Golfo San Jorge Radio, in the locality of Caleta Olivia.

It should be noted that there are 39 television stations in the entire country, 30 of which are private commercial stations, eight are government commercial stations and one is a non-commercial government station belonging to the University of Tucuman. Also operating are 84 repeaters which comprise 17 (commercial) repeating systems, one of which is government-owned and the rest private.

In Buenos Aires, there are four TV stations in operation, with the following technical features: Channel 13, 103 kw effective broadcasting power; Channel 11, 115 kw effective broadcasting power; Channel 9, 82.5 kw effective broadcasting power; and Channel 7, with 40 kw effective broadcasting power.

Insofar as the radio broadcasting infrastructure is concerned, there are 154 stations operating on the hectometric wave band, 30 of which belong to the government service, used non-commercially, while the remaining 124 are commercial: 76 private and 48 government-owned.

The broadcasting stations operate with the following features: five 100 kw stations; five with 50 kw; 56 with between 20 and 50 kw; 15 between 10 and 20 kw; 30 between 1 and 10 kw; and 60 with under 1 kw.

In the decametric (short) wave band, there are six loud sound radio broadcasting stations which operate 16 high frequency channels sent abroad. Moreover, there are 25 loud sound radio broadcasting stations with frequency modulation on the metric wave band, which operate in various towns in the interior part of the country and in the federal capital.

We have made this brief account in order to underscore the leading position held by Santa Cruz Province in the realm of telecommunications, especially in the television sector.

Official Radio Station's Service

Buenos Aires LA PRENSA in Spanish 23 Dec 79 p 9

[Text] We were told by the Santa Cruz provincial radio station: "It has 25 kilowatts and a power, with its frequencies, of 780 kilohertz, in modulated amplitude; 99.3 megacycles in modulated frequency and its 3,245 and 6,080 short wave channels for the 67 and 49 meter bands, respectively; 20 hours of transmission from Monday to Friday, and 22 on Saturdays and Sundays; a civic structure based on the best radio facilities in the country, and programing which abides completely by the radio broadcasting principles of informing, educating and entertaining; and an area of coverage which extends beyond the borders of Santa Cruz as far as the Falkland Islands, to the

[Question] What are the features of the TV channel?

[Answer] At the present time, it has virtually all the equipment necessary for color, cassettes, quadruplex machines, televised screen island, etc. They enable us to receive images in color within the studio.

The remaining equipment has already been bid on, and, very soon, the Rio Gallegos population will be able to enjoy color TV.

At the present time, the main channel also supplies eight direct repeaters, partly through ENTEL's [National Telecommunications Company] microwaves and partly with its own connecting systems.

The repeaters are located in the areas of Comandante Luis Piedrabuena, Puerto Santa Cruz, Puerto San Julian, Puerto Deseado, Las Heras, Pico Truncado, Canadon Seco and Caleta Olivia. In this way, 70 percent of the population of Santa Cruz is being provided with direct television at present.

Within a very few days, four delayed TV repeaters will go into service in the localities of Perito Moreno, Los Antiguos, Gobernador Gregores and El Calafate; and, by February of next year, a direct repeating station is planned for Jaramillo, which will also provide service to Fitz Roy.

This will accommodate the entire province, insofar as TV service is concerned.

It should also be stressed that, although they do not come under provincial jurisdiction, there are two TV channels in El Turbio, one private with a closed circuit, and another open one belonging to Government Coal Deposits. Moreover, UL 85 Channel 9, in Rio Gallegos, sends programs through ENTEL's microwaves to the channels in Rio Grande and Ushuaia, in Tierra del Fuego.

If we consider the fact that the population of Santa Cruz is about 100,000, and that it has a main channel and 13 repeaters, as well as the dependent channels, we find that the province is a leader insofar as TV is concerned.

I should also add that these repeaters will go into operation in color gradually, when Channel 9 in Rio Gallegos does so.

TV Facilities Described

Buenos Aires LA PRENSA in Spanish 23 Dec 79 p 9

[Text] In Santa Cruz Province, insofar as television is concerned, a main channel and 13 repeater stations, plus independent channels are either in operation or will soon be operating.

In the area of radio broadcasting, there are four stations, namely, LU 14 Santa Cruz Province Radio, LU 2 Rio Gallegos Radio, UL 23 Rio Turbio, a south; Chile, to the west; and Comodoro Rivadavia, to the north (through its repeater installed in the locality of Las Heras), forming the present LU 14 Santa Cruz Province Radio service." The broadcasting station comes under the Public Information Secretariat of that national state.

We were also told: "Twenty years have elapsed since that Law No 54, issued in October 1959 by the province's legislative branch, stated in its first article: 'the provincial state radio broadcasting station, to be known as Santa Cruz Province Radio, is to be created.'

"It is 18 years since 1 May 1961, when, for the first time, the radio station, then headed by Eduardo Luis Ezpeleta, sent its first message. Since that time (we were told), the provincial radio station has grown and set itself up as a sovereign messenger service throughout the length and breadth of Santa Cruz, and as an irrefutable witness to the ethical and moral principles of the nation."

PHOTO CAPTIONS

1. Studio of Rio Gallegos Channel 9, recently refurbished.

2. View of the premises of the Santa Cruz main television station, which will have 13 repeater stations.

3. The microphones of LU 14 Santa Cruz Province Radio, the power of which is carried beyond the provincial borders.

4. Television screen island of the Rio Gallegos channel. It is now operating in color for slides and films.

5. View of the equipment of Santa Cruz Province Radio, a leader of sovereignty in the southern part of the country.

2909
CSO: 5500

NATIONAL INTERCONNECTION SYSTEM LINKS WITH SALTO GRANDE

Buenos Aires LA NACION in Spanish 23 Dec 79 p 13

[Text] The "energizing" tests were made on the (500,000 kw) high tension line connecting Salto Grande with the National Interconnected System (SIN), in the General Rodriguez station crossing through Colonia Elia.

After an initial obstacle, which was promptly located (a group of tall trees short-circuited the line) and removed, the tests were repeated, and the line operated without problems, in accordance with the operating methods stipulated in its design.

The weekend and Christmas celebrations delayed its final entry into service, which was postponed until Wednesday.

This interconnection represents a contribution to the SIN of about 140,000 kw, a power to which are added the 60,000 kw already being received through the old 132,000 kw line linking Concordia, Concepcion del Paraguay, Parana and Santa Fe.

The opening of this line will also permit the transmission of the power generated by the new Salto Grande turbines (each with 135,000 kw), which are going into operation. Two of them are already in service, and one will be added every 2 months until they total the 20 completing this hydroelectric powerplant.

Backing from IDB

The Inter-American Development Bank (IDB) approved a non-reimbursable technical transaction equivalent to $360,000, to be used to finance studies on the identification and determination of projects related to the development of the sphere of influence of the Salto Grande hydroelectric powerplant. The aforementioned area covers about 130,000 kilometers, and has a population of over 900,000 inhabitants. It also includes two subareas, located in our country and in Uruguay, typified by a low rate of economic activity. It is estimated that the annual per capita income is $275 for the Uruguayan department of Salto, and $500 for Entre Rios Province.

2909
CSO: 5500

FIRST RURAL TELEPHONE EXCHANGE INAUGURATED

Buenos Aires LA NACION in Spanish 28 Dec 79 p 10

[Text] Yesterday, in the town of Salto, in Buenos Aires Province, the first exchange of the multiple access rural telephone system, devised to interconnect those residing in rural entities with the national and international telephone network, as regular subscribers

This system was arranged by the "ational Telecommunications Company (ENTEL) in response to the concerns of the agricultural and livestock producers and the governmental and private entities operating in rural areas that are without telephone service. The system consists of a radioelectric station, known as a base station, which operates in the branches of the telephone exchange itself in whatever town is involved. This station has a powerful antenna capable of picking up the broadcasts from the radioelectric stations set up in the residences of the users who are located within a radius of approximately 50 kilometers.

Another Subscriber

In order to learn further details about this new system, LA NACION interviewed the ENTEL's director of news media, Col Juan Carlos Fappiano, who said: "The rural telephone service users receive the same service as any subscriber. The only difference is that they have a radioelectric station set up in their residence, but it is run with an ordinary telephone set which connects them with the urban radio network, which for them is the nearest town, the interurban network, which is the rest of the country, and the international network, in other words, the entire world, without paying additional rates. What is different in these instances is that the subscriber must purchase his equipment from the companies producing it, in accordance with the technical specifications of the Communications Secretariat; and he must establish a financial entity along with the other users. The purpose of the latter is to enable them to receive credit assistance on terms similar to those granted for rural electrificiation; and, with the surplus from the investment required of them to set up the household antenna, to pay for the main antenna."

Populated Areas

In response to another question, Colonel Fappiano stated that this system is perfectly suited for populated rural areas such as those in the provinces of Buenos Aires, Santa Fe, Cordoba and La Pampa. He remarked: "We estimate that 200 exchanges could eventually operate throughout the entire country, a number which would meet the requirements." And he announced that other stations would soon be set up in Olavarria, Ayacucho, Tres Arroyos, Lincoln, Junin, Tandil, Coronel Pringles and Rojas, in Buenos Aires Province, and General Pico, in La Pampa. He declared: "The enthusiasm that this initiative has evoked is very great, but we must allow time for the production of the equipment needed for their establishment."

2909
CSO: 5500

LOCAL SIEMENS INSTALLS SECOND TELEPHONE EXCHANGE IN SARANDI

Buenos Aires LA NACION in Spanish 28 Dec 79 p 13

[Text] At 1100 hours today, the second unit associated with the telephone exchange in Sarandi, in Buenos Aires Province, will be inaugurated. The new equipment will allow for the installation of 10,000 telephones, and its assembly is being handled by the Siemens Argentina company.

This facility will increase the capacity of the Sarandi telephone complex to 20,000 lines, and there are plans for a rise of as much as 50 percent in its final capacity. The cost of the projects was estimated at over 16.744 billion pesos.

Facilities in Stroeder and Hernando

Also today, the expanded facilities of the services rendered by ENTEL [National Telecommunications Company] in the locality of Hernando, in Cordoba Province, will be opened.

The facilities will make it possible to supply 200 lines for subscribers, and their cost totaled 429,100,000 pesos.

Finally, in Stroeder, a locality in the Patagones district of Buenos Aires Province, the telephone service will be expanded with 100 additional lines. The projects, consisting of the opening of a new automatic exchange, were carried out through the financial cooperation system, and the budget for them was estimated at 216 million pesos.

2909
CSO: 5500

ARGENTINA

BIDS OPEN FOR ELECTRIC LAYOUT IN CORRIENTES

Buenos Aires LA NACION in Spanish 26 Dec 79 p 14

[Text] Corrientes--31 March was set as the date for the opening of the bidding on the execution of the project entitled "NEA-Coastal Electrical Interconnection Network" (RIEL-NEA), which will consist of the installation of a 500 kv line between Santo Tome, Santa Fe and Resistencia, and the link between the latter terminal and the city of Corrientes.

The announcement was made during the course of a meeting with participation by the head of COFIRENE [Northeast Electrical Network Financing Corporation], and minister of economy of this province, Agustin Esteban Argibay Molina; the public works minister of Santa Fe, engineer Santiago Balloro Lema; the undersecretaries of state for public works and services of Chaco and Corrientes, engineer Francisco A. Turconi and land surveyor Julio Jorge Palmeiro; and the executive secretary of the board of directors for the project, accountant Carlos A. Ojeda.

The joint plans of the provinces of Corrientes, Chaco and Santa Fe, the State Water and Energy Company, COFIRENE and the Investment Bank, S.A. also include the construction of two transformer stations, with a total cost estimated at $150 million.

2909
CSO: 5500

BRIEFS

COLOR TELEVISION RELAY STATION--Paso de Los Libres, Corrientes, 20 Dec (TELAM)--A color television relay station has been dedicated in this city near the Brazilian and Uruguayan borders. The new equipment has been installed at LT-12 Radio General Madariaga. [PY221417 Buenos Aires Domestic Service in Spanish 1600 GMT 20 Dec 79 PY]

CSO: 5500

BRIEFS

RADIO STATION LICENSES--A government decree has authorized Radio (Campodisao), Ltd, to build a medium wave radio station for local use in Campisao, Santa Catarina State. Another decree authorizes Radio Cultura, of Para State, to take over the licence granted to Radio Educativa of that state. [Brasilia Domestic Service in Portuguese 2200 GMT 4 Jan 80 PY]

CSO: 5500

TELECOMMUNICATIONS MANAGEMENT, LOAN AGREEMENT SIGNED

British Cable and Wireless

Gaborone DAILY NEWS in English 19 Dec 79 p 1

[Text]

The Minister of Works and Communications, Mr. P.S. Mmusi yesterday signed a Telecommunications Management and Loan Agreement between the Government and Cable and Wireless.

This Agreement provides that Cable and Wireless, which is a company wholly owned by the British Government, should in the next thirteen years, provided the agreement is not terminated earlier, manage Botswana's national and international public telecommunications services through the Government now and later through the Botswana Telecommunications Corporation.

The agreement is to endure for thirteen years with effect from August, 1979 and although the agreement has just been signed, nevertheless it is effective from 1st August, 1979 because during the negotiations in June, 1979 the parties agreed on broad principles and to that end concluded a memorandum of understanding and later an exchange of letters so that the work should commence on 1st August, before the conclusion of a detailed agreement. However, there are provisions of how the agreement may be terminated by any party before the end of the thirteen years.

At present Cable and Wireless is working through an Interim Committee composed of public officers who have been appointed by the Ministry of Works and Communications. This Interim Committee is also making preparations for the formation of a Telecommunications Corporation which will be a parastatal corporation. This Corporation is to be formed by April, 1980 because it has to be set up by statute and it is envisaged that a Bill will be ready for the Budget session.

Consequent with this reorganisation, the present Posts and Telecommunications will be split between Posts on the one side and Telecommunications on the other side. Posts will remain as a Government Department and Telecommunications will be a parastatal corporation.

In carrying out its management fuctions Cable and Wireless will second its staff to the Government at the present time and later to the Corporation and these seconded offers will be controlled by these respective administrations for the duration of their secondment like any other employees and there is no question of handing over the complete control of Telecommunications to Cable and Wireless.

These seconded staff will be controlled by the Interim Committee now and later by the Board of the Corporation. The estimated number of seconded staff is 23 of which 6 will be for short term secondments of between 6 months and a year for emergency rehabilitation of lower level networks. One of the seconded staff will be the Chief Executive of the Corporation.

As regards the present public officers manning the Telecommunications side, they will according to the present secondment rules of the Government be seconded to the Telecommunications Corporation after it has been formed for a period of one year. After one year's secondment, the officers may then opt to serve permanently in the Corporation or to go back to the Civil Service. Even officers who opt to work permanently for the Corporation will not lose their present benefits which have vested on them as public officers and as a result they will be entitled to all their pension rights on retirement.

The agreement provided that Cable and Wireless shall train all Batswana to carry out specific duties in the Corporation. The training will be three phases — in the short term in Botswana to carry out specific tasks, in the medium term in other African countries and in the long term in United Kingdom and at Cable and Wireless's Head Office in London. Of course, this does not preclude the Corporation from sending its employees for training in any other country.

The Corporation will be entitled to appoint counterparts to Cable and Wireless's seconded staff to facilitate the smooth handing over of the duties to Batswana in future.

Cable and Wireless has under this agreement provided a loan of P10 million to be invested in telecommunications capital projects. Already part of this loan has been used in purchasing an earth station which is being installed near the Khale Hill on the St. Joseph's Mission farm and supporting facilities are as well being constructed such as the control room and houses for monitoring staff. It is envisaged that the earth station will be in operation by April, 1980 when the Telecommunications Corporation is inaugurated. The loan is to be repaid in ten years beginning from the 4th year of this agreement.

As a consideration for its management services Cable and Wireless will receive base payments and in addition other payments will commensurate with their performance from year to year — thus any payments in any one year will be based on their performance achievement in their management services. Cable and Wireless will then have an incentive to perform well every year in order to maximise the payments.

The Government negotiating team was composed of Mr. N.T.K. Mmono as head of the team and others were Messrs. P.H.K. Kedikilwe, B.G. Makobole and C.M. Lekaukau. The Chief negotiators of Cable and Wireless were Messrs. D. Buck and J. Slaughter.

Parastatal Telecommunications Corp.

Gaborone DAILY NEWS in English 20 Dec 79 p 1

[Article by Keboeletse Nkarabang: "Programme To Improve Communication in 6 Months"]

[Text]

Cable and Wireless is engaged in a tight programme to introduce improvement in Botswana's telecommunications network in the next few months.

The British owned company took over the management of the Telecommunications part of the former "Department of Post and Telecommunications" in August with the view to forming it into a parastatal Botswana Telecommunications Corporation.

The interim company is currently steered by a committee which is making preparations for the establishment of a fully fledged corporation in April next year.

But Cable and Wireless has gone deep into spade work to improve telecommunication systems within the country.

It is hoped that by the end of January, next year Botswana will be eased of dependence on South Africa for her international telecommunications.

A one-and-half million Pula, first ever Statellite Earth Station for Botswana is nearly complete at Khale, 10 kilometres south of Gaborone.

Chief Executive Officer for Cable and Wireless, Mr Peter Hollands, said in an interview with the Daily News this week that: "The station will provide high quality international communication to all parts of the world.

The station is slated to bbe opened for business towards the end of January next year. Its installation by the Cable and wireless with the assistance of the "splitting" Department of Post and Telecommunications started in August.

Mr Hollands said that calls to South Africa would however, continue to be relayed on the existing overland route, because other than avoiding over load the satelite this, he said was still cheaper on the cross-boarder routes.

There are yet two more projects — one being the upgrading of micro wave link amongst the four main urban centres of Botswana — Gaborone, Lobatse, Francistown and Selebi-Phikwe.

The project has already commenced between Gaborone and Lobatse. It will shift to Gaborone-Francistown and later to Gaborone-Selebi Phikwe.

Equipment estimated at P1 million is being deployed in this project which is expected to wrap up within six months, according to Mr Hollands.

The third leg of the programme take the commercial surveying of national telephone system which will take six to nine months to complete.

The outcome of this survey will according to Mr Hollands determine the development plans of Botswana telecommunications system in the next ten years.

He told the Daily News that the survey's initial results were already in hands. The initial results, he said have shown demand for more telephone service and action was being taken to increase telephone service throughout the country.

Places covered in this respect are, Lobatse, Francistown, Serowe, Orapa, Mahalapye, Selebi-Phikwe and Gaborone.

In the meantime parallel training schemes covering the technical and management fields are also being deployed to support the existing system in its modernisation and expansion, Mr Hollands revealed.

Cable and Wireless has under this arrangements provided a loan for P10 million which was signed by the Minister of Works and Communications, Mr Peter Mmusi on Tuesday to be invested in communications and capital projects.

CSO: 5500

MINISTER ANNOUNCES TELEPHONE INSTALLATION PLANS

Kaduna NEW NIGERIAN in English 19 Dec 79 p 1

[Article by Suleiman Dangana]

[Text] Telephone lines in the country would be expanded from 160,000 to 200,000 by June next year, Minister of Communications, Alhaji A. M. Oniyangi, disclosed in Lagos yesterday.

The Ministry of Communications, he said, had also set a new target to ensure that by that time 16 new telephone and telex exchange plants for external communication would have been commissioned.

He said the programme was designed to cut down the waiting period prospective telephone subscribers in urban centres had to endure before they could be served with telephone lines.

The minister was speaking when he formally commissioned Lagos 'D' Telephone and Telex Exchange.

The exchange has 5,000 subscribers as at now and would be expanded to 10,000 by June next year.

The areas to be served by the exchange are triangularly bounded by the Marina-Nnamdi Azikiwe Street, up to Carter and Eko Bridges.

The minister assured the people of these areas that from now on, the ministry would guarantee effective local and international telephone and telex services.

He pleaded with subscribers for telephone installations to be patient even if they had already made the necessary payment for the service.

He said the backlog of applications and the priority needs were so enormous that it would take some time before installation. Alhaji Oniyangi appealed to subscribers not to open themselves to exploitation by unscrupulous elements who go about demanding gratification to influence events.

The minister appealed to developers of multi-story office complexes and residential accommodations to seek for advice as to what facilities should be provided in the buildings to facilitate telephone installation.

BRIEFS

ABEOKUTA TV FACILITIES--The Ogun State Governor, Chief Bisi Onanbanjo, has called for the decentralization of the television services in the country, in order to make them more effective in the discharge of their duties. Exchanging views with members of the board of the Nigerian Television Authority NTA (Zone A) who called on him in his office at Abeokuta, last weekend, Chief Onabanjo stated that television services should be independent of the government, if it was to justify its existence. Meanwhile, the Nigerian Television (NTV) Abeoukuta, is to spend one million Naira for the provision of additional facilities in order to improve its services to the people in its area of coverage. Out of the amount, 500,000 Naira would be spent on the erection of a 15 kilowatt transmitter to replace the present 1-kilowatt transmitter, while the remaining 500,000 Naira would be expended on the purchase of modern studio equipment to enhance the service of the station. [Excerpts] [Kaduna NEW NIGERIAN in English 18 Dec 79 p 21]

CSO: 5500

EUROPE'S ONLY PRIVATE-INDUSTRY DATAVISION SYSTEM STARTED

Helsinki HUFVUDSTADSBLADET in Swedish 19 Nov 79 p 8

[Text] Read tomorrow's newspaper the evening before. You can choose the time yourself. Where stock exchange information, advertisements, the latest news and sports results are concerned, ask your TV!

Messages within the family can be left on the TV screen. Just as naturally as when you go for the afternoon mail, you will look in the family's computer to see whether any messages have come in during the day.

During the evening, you will watch TV programs as usual. In the morning, for example, you can check the road conditions before you start out, and do so in the same piece of apparatus--your TV.

The system is called "Telset," which is the new communications system which will go into operation early in 1980! "Telset"--in Sweden the system is called Datavision and in the international usage people have begun to use the name "Videotex"--is a system with a home terminal (the television set) which receives information from a central computer and which, in the expanded version, can also send out its own messages.

This means, for example, that subscribers, in addition to being able to communicate with each other over their TV screens, also receive news, stock exchange information, sports results and recent weather reports on their TV screens at home while at the same time, for example, they can order products from the supermarket and pay for them by sending an order to pay to the bank through the TV! In England, the equivalent system is called Viewdata or Prestel.

It is Viewdata which got to serve as a model for all the systems which came along later: Bildschirmtext in West Germany, Datavision in Sweden and Telset here in Finland.

Nevertheless, Sanoma Oy, Nokia Elektronik and Helsingfors Telefonforening, which are in charge of the Finnish project, maintain that they have provided Telset with a national Finnish personality of its own and that it was mostly for the sake of standardization that they followed the English model. "I would say that our situation in this area in Europe is good just now," says technical director Jaakko Hannuksela, of Sanoma Oy.

Has Cost 3 Million Marks

Described briefly, the Telset technology builds on a television set, the existing telephone network and data processing.

Sanoma Oy, which publishes the HELSINGIN SANOMAT, the ILTASANOMAT and five big periodicals, is responsible for the editorial side.

Nokia Elektronik provides the data processing and the softwares.

Helsingfors Telefonforening is responsible for the telephone technology.

Up to the present, the project has cost between 2.5 and 3 million marks. That is not so very much when one thinks of the fascinating possibilities for development offered by this technology, Pekka Jaakola, the head of Telset in Sanoma Oy, believes.

"For the next 5-year period, we will be budgeting on the basis of approximately 5,000 subscribers--that is 4,700 private individuals and 300 firms--and perhaps 25 to 30 regular producers of information," he says.

An Editorial Staff of 20

"The organization includes an editorial staff of approximately 20 people (during the initial period, when we were getting underway, there were 3) who work in accordance with journalistic principles and whose editor in chief is responsible in accordance with the press law in the usual way. The responsible editor is Reino Lantto, who formerly was a trade and industry journalist for the HELSINGIN SANOMAT.

He told the HUFVUDSTADSBIADET the following:

"One 'screen'--that is, one side of the Telset TV--has room for 2 lines of text, each having 40 strokes and 960 symbols. In practice, there are three short fragments, approximately like the leads of a news telegram.

"That is not much, and therefore the material must be tightly screened and edited.

"The Telset editorial staff is already working entirely separately from the Sanoma Oy's other editorial staffs."

In that way, it is to be brought about that cooperation will take place first with the data bank which belongs to the system and serves a hundred client firms, and also with other prospective big distributors of text and data information. Actually, news service constitutes only an insignificant part of the Telset program.

Unique Situation

Telset's situation is unique since Finland is the only country in Europe where they have been able to build up the Datavision system on a private basis, through private firms. In England, Prestel is owned by the British Post Office. Last fall, the Swedish Information Technology Committee put out its first report on the attitude society will take toward new technologies like text-television and Datavision. The committe takes up the hazards for the mass media which unquestionably will exist. For example, what is going to happen to the existing daily press? Will the situation of the other newspapers become even weaker because of the introduction of the home television terminals?

Other ideas which were brought out were concerned with the law on data, copyrights, the law with respect to radio and questions in connection with freedom of speech.

Strangely enough, those are questions which have not been important in Finland up to the present.

One reason for that is the fact that most of the telephone companies in cities and population centers are privately owned. That makes for better possibilities for cooperation locally than if the telephone lines were owned by the government.

Selling Services to Others

"It is obvious that the limitations on media policy have also indirectly affected the technical developments, which now are controlled by Viewdata and England," says Director Hannuksela. Telset is the only, small exception in Europe. It operates with its own technology and with a system of its own.

Director Hannuksela says, "The fact that Sanoma Oy is involved in the project does not prevent Telset from being able to sell 'printing services,' even to other mass-media firms--the HUFVUDSTADSBLADET, for instance.

It is important for the newspapers, together, to emphasize the fact that the newspaper companies, and not the radio-television monopoly, are included among the "telefacsimile" enterprises, as the most recent report on communications policy quite rightly indicated.

Financial Profit

The costs of the Telset system consist of the cost of the terminal television sets themselves, the cost of the telephone connections and the charges for the use of the informational material.

Certain information can be supplied free of charge, while other information could possibly be financed with the income from advertising.

"The system is intended to provide a financial profit. If Telset manages to get the 5,000 subscribers for whom we have budgeted, the enterprises will be profitable. The possibilities for expansion beyond that are, of course, unlimited," Oy Nokia AB's chief of public relations, Hakan Nordqvist, points out.

The largest expenditures will be approximately 7,000 marks for receiving TV terminals, 150 marks per month for modem rental and from nothing to perhaps 20 or 30 pennies for conversations and the cost of lateral reading.

Jaakko Hannuksela says, "In Sanoma Oy (turnover last year: 409,000 marks), we do not think that Telset is going to have any special economic significance during the next 10 years.

The decade of the 1980's will be the one in which it becomes established. It is then that it will be important to be involved, so that we do not get left behind by technological developments.

In fact, that is already the direction in which they are moving in other countries, as far as the newspapers are concerned.

Facts about Telset

Telset is adapted to the English Viewdata system.

Telset is being developed by Sanoma Osakeyhtio, Helsingfors Telefonforening and Nokia Flektronik.

Telset supplies information by way of the telephone and TV.

Telset uses information stored in computers.

Telset has unlimited possibilities for storing information.

Telset is an electronic, two-way, interactive medium.

Telset contains both open and closed information.

Telset information can be selected individually at the desired moment.

Telset information can be repeated rapidly

Telset has black-and-white and color TV screens.

Telset has a picture screen which can accommodate 24 lines and 960 symbols.

The experiment started in mid-1978 with 30 terminals. At the beginning, 50,000 picture screens will be accommodated in the computer.

9266
CSO: 5500

ITALY

FACTORS AFFECTING THE CAPACITY OF OPTICAL FIBRE LINKS

Milan ALTA FREQUENZA in English Oct 79 pp 396-404

[Article by Luciano Bosotti, Giovanni Tamburelli of CSELT - Centro Studi e Laboratori Telecommunicazioni, Torino]

[Text]

Abstract. This paper gives the results of a study on optical fibre links. The calculations carried out show the possibility of using optical fibres also for very long distances and some advantages of digital optical fibre links over conventional coaxial cable analog links. Linear and nonlinear equalizers are considered and compared assuming the use of both p-i-n photodiodes and avalanche photodiodes. Transmission of multilevel optical signals is also examined, which appears to be particularly suitable for fibre communication. It is demonstrated that utilizing the most recent types of optical components it is possible to operate at a bit rate of the order of 20 Gbit/s with a range of 40 km without the use of repeaters.

The use of several optical carriers on a single link via wavelength division multiplexing is also considered as a feasible way to expand the flexibility and potentiality of optical fibre systems.

1. INTRODUCTION

The technological evolution in the field of telecommunications has brought about very important developments which have substantially transformed the structure of telecommunication systems allowing a considerable improvement in performance, compactness and operating safety.

Nevertheless, such an important evolution is still very far from final goals. Therefore we can reasonably expect in the future a continuous technological development leading to the introduction of new systems with exceptional characteristics [1, 2]. Consequently, in such a technological situation forecasting studied on both components and systems become extremely important.

This paper describes forecasting studies carried out for optical fibre systems.

2. TRANSMISSION CAPACITY OF FIBRE LINKS

Recent experimental installations have already shown the possibility of using optical fibres on quite short distances in the local and sector network. The forecast technical and economic advantages are well-known [3, 4]. Nevertheless, new techniques for components, particularly laser sources and photodetectors, involve further developments for laser systems.

In particular, the introduction of components operating in the 1.0-1.3 μm spectral region allows laser systems with very low attenuation and dispersion to be designed. Therefore, optical fibre systems present interesting utilization perspectives even for long distances. This result is very important for at least two aspects.

604 - 396 E

The first one is the possibility of implementing all-digital networks using optical fibres. In fact, it is known that over long distances FDM systems are still more advantageous than PCM systems. Optical fibres, on the other hand, could lead ultimately to the establishment of a wholly digital transmission system.

The second one is the possibility of implementing, with the introduction of optical fibres also over long distances, an all-glass transmission network. The homogeneity of this type of network entails obvious advantages from the operating point of view; therefore it would be worthwhile considering the introduction of switching exchanges using optical components.

In fact, there has already been notable progress in optical switching, as shown in the literature [5, 6, 7] and the development of the related systems fully depends on the preparation of new components.

With optical components available at present the implementation of long-distance and high-capacity optical fibre connections seems already feasible. In particular, the use of the 1.0-1.3 μm spectral region and monomode fibres allow low attenuations, below 0.75 dB/km, to be obtained, as shown by the experimental results illustrated in [8]. It is known that the dispersion due to material can be null with a 1.29 μm wavelength [9]; in this case only guide dispersion, which is very small, is present. As a consequence, at this wavelength monomode optical fibres have a very high transmission band and the usable bands are limited essentially by terminal photoelectronic components and transistor amplifiers. The possibilities of exploiting the high transmission band of optical fibres are both numerous and compatible and, when exploited simultaneously, can give rise to really amazing transmission capacities. In fact, optical fibres can be used with these multiplexing systems: the

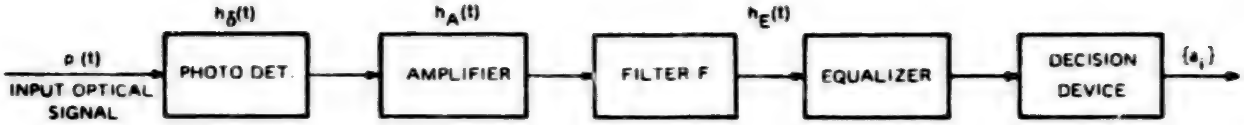


Fig. 1 - Basic receiver model for optical communications

common time division multiplexing, the contemporary use of wavelength division multiplexing, utilizing several optical carriers.

Considering also the possible increase in transmission rate by using non linear equalizers [10, 11, 12], the full capacity of the optical fibre can be expressed by the following relationship:

$$C_0 = \beta C_B N_p \log_2 L, \tag{1}$$

where C_B is the capacity corresponding to the Nyquist band relative to the leading edge of the pulse at the fibre output, β the increase, in ratio, of this capacity obtained with the equalizer, N_p the number of carrier frequencies and L the number of levels transmitted in-line assumed, with C_B and β, to be constant for each carrier frequency.

It is obviously interesting to predict values for these parameters, owing to further technological developments, even if the very high values obtainable for C_0, which are generally unnecessary, involve the technical-economic problem of obtaining a given capacity through a right choice of the values of the parameters considered in (1).

3. ADVANCED COMPONENTS FOR OPTICAL FIBRE COMMUNICATION

To have an indication of the values obtainable for βC_B, we have studied the model shown in fig. 1. This model considers a monomode optical fibre with a 0.75 dB/km attenuation, quoted in [13].

It is necessary to consider that the dispersion at this wavelength is negligible up to a fibre length of 30 km, as shown in fig. 2, where dispersion is calculated according to [14].

The same figure shows also the results of a null dispersion due to the material at 1.29 μm wavelength. The very low dispersion could however be greatly increased by some manufacturing imperfections of the optical fibre.

As regards laser diodes, current technology seems to be moving towards the implementation of Ga In As P/In P double heterostructure diodes. As an example, [15] quotes the data of such a diode emitting a power of about 8 mW between 1.1 e 1.25 μm.

The possibility of obtaining extremely narrow pulses and direct modulation at a few GHz of this type of diode has been recently demonstrated [16].

To the aim of evaluating possible performance it seems reasonable to assume that optical pulses with an approximately Gaussian form having a $\sigma = 75$ ps standard deviation and a 5% base width equal to 365 ps can be obtained at the receiver input after propagation over tens of kms of monomode fibre. The wavelength of the laser beam is considered to be equal to 1.06 μm, so as to take into account recently published data relating to photoelectronic components operating at this wavelength. A model for the photodetector can be defined starting from the "specifications" set in [17] for an avalanche photodetector at 1.06 - 1.27 μm, and from the experimental results presented in [18] and [19].

The numerical values of 0.85, 0.1 and 20 can thus be selected for the photodiode quantum efficiency, for the effective ionization ratio and for the upper limit of the avalanche gain, respectively. According to [18], the photodiode bandwidth may be estimated to be in excess of 5 GHz.

For the amplifier stage reference is provided by the transimpedance feedback amplifier presented in [18]. In this scheme a special feedback resistance element is used with an extremely low output-to-input shunt capacitance, which allows bandwidths of the order of several GHz to be reached.

4. EQUALIZING RECEIVERS

A typical model of an equalizing receiver for optical fibre communication is that shown in fig. 1. The equalizer indicated in fig. 1 may be one of many types. We have considered the linear transversal equalizer of minimum-mean-square-error (MMSE), the decision feedback (DF) equalizer and the two composite equalizers of fig. 3.

The MMSE equalizing scheme was considered, since this was shown [20] to be particularly effective for equalization in optical fibre communications. That of fig. 3a is a decision feedback equalizer cascaded to a linear filter (DF-LE) to reduce the interference due to the precursor, studied in [21]. The equalizer of fig. 3b is a feedback and feedforward equalizer, preceded by a linear shaping filter (DFF-SF) to prevent error propagation due to the postcursor [10, 11, 12]. The following section illustrates the methods used to evaluate the performance of these equalizers.

4.1. *Linear equalizer*

In this case decision on the transmitted symbol sequence is performed at the receiver on samples taken at times $t = t_0 + iT$ of the filtered photodetected current $i_d(t)$, given by [22]

$$i_d(t) = \sum_{n=1}^{N_t} e g_n\, b_1(t-t_n) + i_{th}(t) * b_2(t), \tag{2}$$

where e is the elementary electron charge = $1.6 \cdot 10^{-19}$ Coulomb, g_n is the random avalanche gain of the photodetector whose statistics are given in [23]. In the case of a p-i-n (no avalanche) detector $g_n = 1\ \forall_n$. $b_1(t-t_n)$ is the impulse response of the photodiode-amplifier-equalizer cascade to the n-th photoelectron emitted at $t = t_n$. Note that, obviously, $b_1(t) = b_\delta(t) * b_A(t) * b_E(t)$, where $*$ stands for convolution. $b_\delta(t)$, $b_A(t)$ and $b_E(t)$ are the impulse responses of the photodetector, the amplifier and the equalizer, respectively.

The second right hand term in (2) represents the distur-

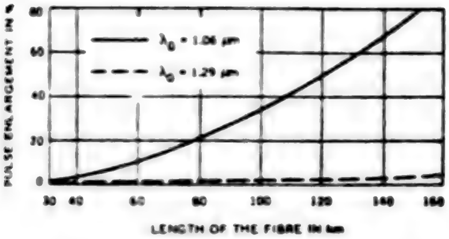
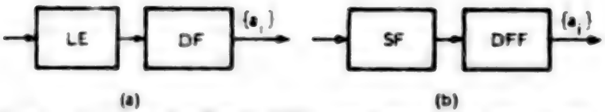


Fig. 2 - Pulse dispersion vs. fibre length for different wavelengths.



(a) (b)

Fig. 3 - Decision feedback (DF) equalizer with linear equalizer (LE) for precursor correction (a), and decision feedback and feedforward (DFF) with shaping filter (SF) to prevent error propagation (b).

bance at the input of the decision device due to the amplifier thermal noise current $i_{th}(t)$ filtered by the amplifier-equalizer unit, with impulse response $b_2(t) = b_A(t) * b_E(t)$.

It must be recalled that correct decision on the received symbols is also impaired by quantum (i.e. photodetection and avalanche multiplication) noise and "dark current" (I_r) noise, deriving from random fluctuations of the first right hand term in (2) around its average value. As a matter of fact, in (2) N_t is an inhomogeneous Poisson process, with intensity $\lambda(t)$ given by:

(3) $$\lambda(t) = \frac{\eta}{h\nu}\, p(t) + \lambda_0,$$

where $p(t)$ is the received optical power, $h\nu$ is the energy in a photon at frequency ν ($h=$ Planck's constant), η is the quantum efficiency of the photodetector, and λ_0 accounts for the spontaneous emission of electrons (dark current).

In the case that non avalanche (p-i-n) photodiodes are used ($g_n = 1$), the following approximation holds:

(4) $$\sum_{n=1}^{N_t} e h_1\,(t-t_n) \cong \rho p\,(t) + i_q\,(t) + i_d\,(t),$$

where $\rho = \eta e/h\nu$ is the A/W responsitivity of the photodiode; $i_q\,(t)$ and $i_d\,(t)$ are two zero-mean gaussian processes, with variances:

(5) $$\sigma_q^2\,(t) = 2\,e^2\,B\lambda\,(t) = 2\,eB\rho p\,(t),$$

(6) $$\sigma_d^2\,(t) = 2\,e^2\,B\lambda_0 = 2\,eBI_r,$$

accounting for quantum and "dark current" noise, respectively. In (5) and (6) B is the one sided equivalent noise band of the receiving filter $h_1\,(t)$. When avalanche photodiodes are employed eq. (4) becomes quite unsatisfactory owing to the difficulty to model the additional noise contribution due to the random character of avalanche multiplication.

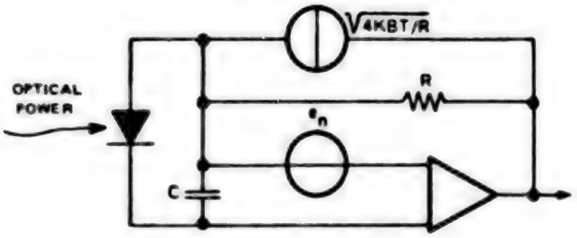


Fig. 4 - Basic scheme of photodiode and amplifier, showing thermal noise sources.

A more refined analysis, based on the theory of Poisson processes, is then required which will be briefly discussed in the following section. The thermal noise contribution $i_{th}\,(t) * h_2\,(t)$ in (2) may be easily modelled by resorting to the basic scheme of the photodiode-amplifier unit portrayed in Fig. 4. The amplifier is assumed to be of the transimpedance type, shown in [18]. Accordingly, two statistically independent noise sources are responsible for the overall thermal noise level, namely:

- the feedback resistance R;
- the equivalent noise generator e_n at the amplifier input.

These noise contributions can be modelled in the form of two zero mean Gaussian processes with variances:

$$\sigma_R^2 = 4\,kTB/R, \tag{7}$$

$$\sigma_{e_n}^2 = \left(\frac{2\pi}{\sqrt{3}} B_1 e_n C\right)^2. \tag{8}$$

In (7) B is the one sided equivalent noise band of $b_2(t)$, which has been chosen to be practically equal to that of $b_1(t)$ due to the extremely wide band of the photodiode.

In (8) B_1 is the one sided equivalent noise band of $b_2(t)$ defined as in [24] taking into account that an amplification factor must be assumed for e_n which is dependent on frequency. Obviously, C represents the full capacitance parallel to the amplifier input. With a MOSFET preamplifier, $e_n = H\sqrt{B_1}$ with $H = 1.34 \cdot 10^{-9}$, as indicated in [18].

By integrating a special feedback resistance element within the first stage it should be possible to keep the input-to-output shunt capacitance across R below 10^{-15}F [18]. Accordingly, the value of the resistance R can be rather high (> 5 kΩ), so that the prevailing noise contribution is that due to e_n.

4.2. *Nonlinear equalizers*

The advantages of using quantized feedback as opposed to linear equalizers for optical fibres are well known [13, 25].

Using a Butterworth filter having about ten poles as filter F of fig. 1 the response to a Gaussian pulse is of the type indicated in fig. 5. By a proper choice of the cut-off frequency of F, only an interfering sample of the precursor results with a value of about 0.4 the peak value. This corresponds, for a received Gaussian pulse, to a symbol rate of about $1/2\sigma$ where σ is the standard deviation of the Gaussian curve. Then only for symbol rates higher than this value the use of decision feedback is necessary.

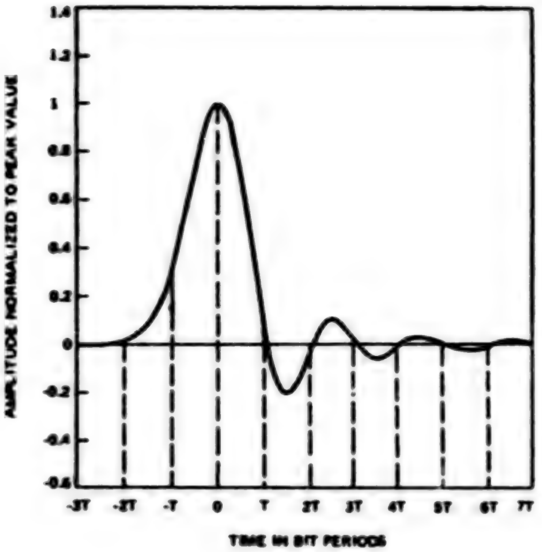


Fig. 5 - Response of a ten pole Butterworth filter to a Gaussian pulse.

In order to improve the performance of DF a filter can be inserted at the input to reduce the interfering samples of the precursor, but since the minimum error probability does not correspond to the minimum MSE, it may be more suitable to use the nonlinear operation approach indicated in [26] for the postcursor. This method can be used minimizing the noise with a limit to the interfering samples of the precursor and repeating tentatively this calculation varying the limit until a minimum of error probability is obtained.

Generally, in this way a very small enhancement of noise results that may even be negative, with an increase of the samples of the postcursor. As may be drawn from [27] an increase of the interfering samples of the postcursor does not strongly affect the error probability. Consequently the sensitivity loss for binary signals does not increase generally more than 1 dB.

In the last type of equalizer considered [12], the DFF-SF equalizer, a SF filter shapes the postcursor so as to avoid error propagation in the subsequent nonlinear equalizer (NLE) which corrects the precursor and the residual postcursor. In this way an error probability is obtained that practically corresponds only to the presence of noise at the output of the shaping filter. The enhancement of noise produced by the shaping filter is the most important factor in increasing the sensitivity loss at high bit rates. It is possible that for binary signals the sensitivity loss is higher that the theoretical value given by the preceding equalizer. However, in any case we avoid in the NLE the disadvantages of an eye diagram that may close at high bit rates and a strong instability due to the correction of a high postcursor. It must be underlined that at not very high bit rates by using a suitable Butterworth filter it is possible to eliminate the shaping filter.

We can conclude that the DFF-SF equalizer gives on the whole the best performance. It is generally possible to operate at bit rates twice the Nyquist rate corresponding to the leading edge of the received pulses. However, for the final selection of the equalizer, the economic problems must be taken into account.

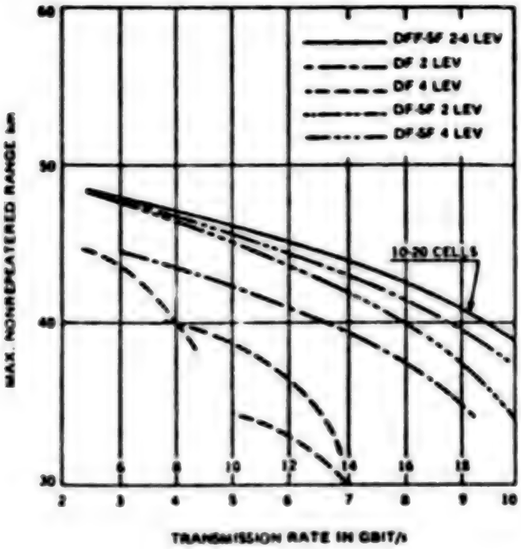


Fig. 6 - Comparison of maximum repeaterless transmission ranges for two level and four level signalling (non avalanche photodiode).

5. EVALUATION OF ERROR PROBABILITY FOR EQUALIZING RECEIVERS

5.1. *Non avalanche (p-i-n) photodetectors*

According to eqs. (4) - (8), the signal-to-noise ratio at the filter output, for a continuous received optical power P, may be expressed as

(9) $$(S/N)_{dB} =$$

$$= 10 \log_{10} \frac{M^2 \rho^2 P^2}{2eB(\rho P + I_r) + (4kTB/R) + \left(\frac{2\pi}{\sqrt{3}} B_1 e_n C\right)^2}$$

where M is a coefficient taking into account the peak value decrease of the "signal" term produced by the filter. Assuming that the received optical power lies in the range -15 dBm to -25 dBm, the quantum and "dark current" noise contribution and the noise in the feedback resistance can be neglected so that eq. (9) reduces simply to:

$$(S/N)_{dB} = 20 \log_{10} \frac{\sqrt{3} M \rho P}{2\pi H C B_1^{3/2}} \qquad (10)$$

Computations have been carried out with reference to a system model with a 3.6 dB coupling loss between the source and the fibre and a 0.6 dB coupling loss between the fibre and the photodiode [13]. In fig. 6 the transmission range obtainable for a 10^{-9} error probability is portrayed for the technological data summarised in section 1 with reference to laser sources and monomode fibres. The calculation of error probability for nonlinear equalizers can be carried out by resorting to the methods presented in [10] and in [27].

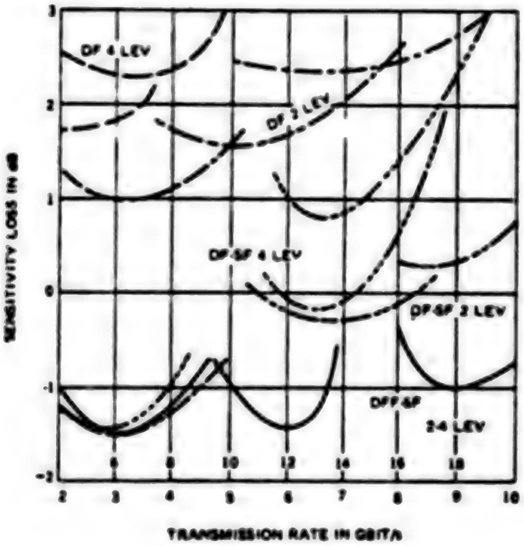


Fig. 7 - Sensitivity loss vs. transmission rate at 10^{-9} average error probability for different types of nonlinear equalizers (non avalanche photodiode).

Three transmission rates, 3 Gbit/s, 6 Gbit/s and 9 Gbit/s have been considered, which are higher than those considered in present literature [13, 28]. The curves have been obtained varying the bit rate (and also the shaping filter and the NLE) while keeping the filter constant. The corresponding sensitivity loss is indicated in fig. 7. It is worthwhile noting that, as fig.5 shows, the pulse shape at the output of the filter at 6 Gbit/s allows the shaping filter to be dispensed with, the postcursor interfering samples being practically zero. Furthermore, it can be seen that, at 9 Gbit/s, the waveform at the output of the shaping filter has a postcursor very well corrected. In both cases the NLE may simply be of the decision feedforward type.

It should be pointed out that the response of the circuit in fig. 4 has been considered to be flat in the equivalent band of the receiving filter.

5.2. *Avalanche photodetectors*

In this case a more refined treatment of the photodetection process is required, based on eq. (2) and (3).

In eq. (3), which expresses the intensity of the counting process in (2), the following expression is valid for the received optical power:

$$p(t) = \sum_{i=-\infty}^{+\infty} a_i b_p(t - iT). \tag{11}$$

In (11) $b_p(t)$ represents the fibre response to the basic pulse at the transmitter, and (a_i) is assumed to be a sequence of statistically independent symbols taking values α and 1 with equal probabilities.

We point out that α cannot be chosen equal to 0, because of incomplete extinguishing of the optical source. Furthermore,

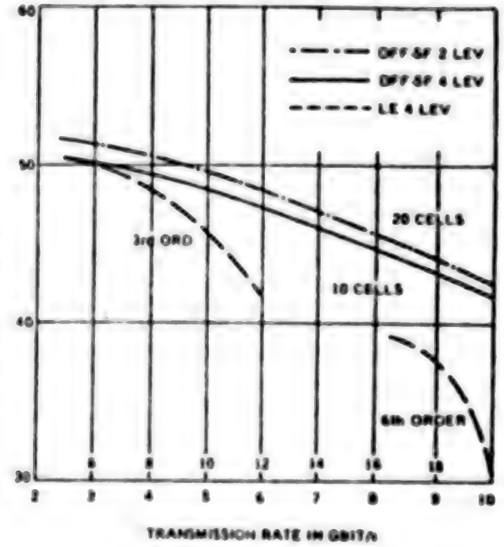


Fig. 8 - Comparison of maximum repeaterless transmission ranges for two level and four level signalling using avalanche photodiodes.

it may be shown that a proper choice of α allows the effects of the dark current term in (3) to be accounted for without excessive computational effort.

Evaluations of average error probability may be carried out with reference to the above outlined system model by resorting to a well known numerical method [29] (1). This method actually permits the influence of all terms in (2) and (3) to be taken into account, so that a realistic appraisal of system performance can be obtained. As a matter of fact, an extension of the computational method presented in [29] has been utilized including a procedure for the selection of optimum avalanche gain and optimum threshold placement.

Also in this case a 3.6 dB coupling loss between the source and the fibre and a 0.6 dB coupling loss between the fibre and the photodiode have been considered to evaluate the useful transmission range for a 10^{-9} average error probability with α equal to 0.1.

The results of these calculations are portrayed in fig. 8 (dashed lines). A third order MMSE equalizing scheme turns out to be adequate in the 3-6 Gbit/s signalling range. On the contrary, a rapid performance degradation is shown to result for higher signalling rates. A more refined (sixth-order) equalizing scheme is thus necessary to provide a satisfactory performance level also for 9 Gbit/s signalling.

It should be noted that in all cases the maximum value of the APD gain (set equal to 20) has given rise to optimum performance. This shows clearly that further improvements of system performance may result from the availability of higher avalanche gain values.

In the analysis of the linear equalizing scheme the overall impulse response of the receiver $b_S(t)*b_A(t)*b_E(t)$ has been assumed to correspond in practice to that of the tapped delay line MMSE equalizer.

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(1) *Reference was actually made to the geometric mean of the results obtained in the two border-line conditions defined in [29].*

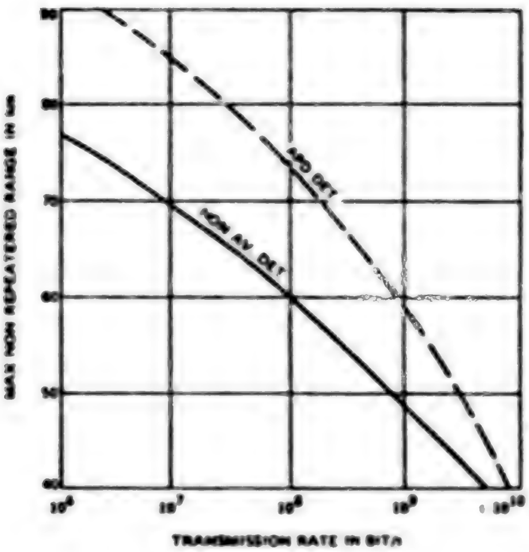

Fig 9 - Maximum repeaterless transmission range vs. transmission rate for DFF-SF equalizers (Binary signalling)

In the performance evaluation of nonlinear equalizers we have assumed that the same components are used as in the case of linear equalizers if not otherwise indicated

A ten pole Butterworth filter has been chosen as the filter *F* in fig. 1 for the nonlinear equalizers. The filter bandwidth has been selected to minimize the error probability for the symbol rates of 3 Gbit/s, 6 Gbit/s and 9 Gbit/s. For the DFF-SF (3) the range has been evaluated using the same APD considered for the linear equalizer. For the sake of simplicity the same SF calculated in the preceding case has been chosen. To calculate the several error probabilities of the first (linear) decision circuit of the NLE the method indicated in [29] accounting for photodetection and multiplication noise has been used. As in the foregoing, the assumption was made that the overall receiver response $b_S(t) * b_A(t) * b_E(t)$ corresponds to that of the Butterworth - shaping filter cascade

In order to stress the enormous potentialities of the optical systems considered in the foregoing the maximum repeaterless range has been evaluated with reference to the DFF-SF equalizer for a wide range of bit rates. The results, summarised in fig. 9, show that for moderate signalling rates (< 50 M bit/s) values of the repeaterless transmission range in excess of 75 km can be obtained, which are highly interesting for submarine cables and similar applications

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(3) *For the DFF-SF a uniform noise spectrum in the amplifier has been considered, since this has been shown to give the best results.*

6. MULTILEVEL SIGNALLING ON OPTICAL FIBRES

The wide band available for optical fibres would appear to make the use of multilevel transmission unnecessary in this new type of line. Nevertheless this wide band requires unavailable or very expensive hardware and the use of multilevel can give correspondingly a feasible or a more economical solution for obtaining a given capacity.

Interest has already been shown in multilevel transmission on optical fibres [30], with reference to different types of line formats [31]. As regards multilevel pulse amplitude modulation, in [32] the optimal choice of decision level positioning and of pulse amplitude is studied taking into account shot noise, and considering perfectly equalized pulses, i.e. without intersymbol interference.

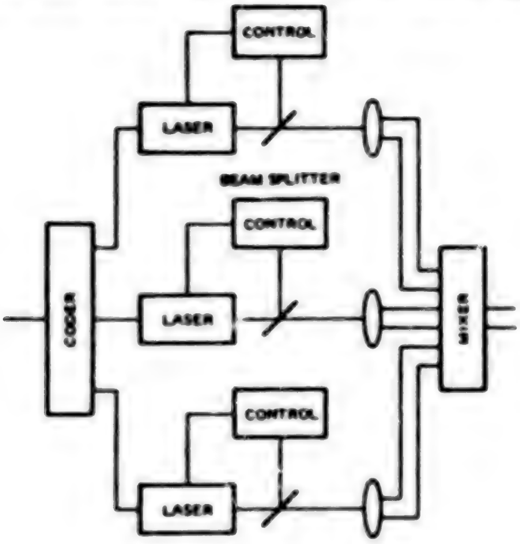

Fig.10 - Device for four level laser beam generation.

In [25] and [28] the same properties are studied considering a certain interference due to the two nearest pulses.

It is our belief that multilevel PAM is particularly suitable for optical signalling due to the square law nature of optical detectors. As a matter of fact, increasing to N the number of levels at the decision circuit (fig. 1), keeping a constant level spacing (3), simply requires $N-1$ times as much optical power to be received. In standard radiofrequency or microwave transmission, on the contrary, the amount of received power for N levels is in the general case $(N-1)^2$ times greater than that required for binary signalling. However, serious implementation problems may arise, owing to the difficulty of stabilizing the power emitted by the laser diode at values lower than the maximum.

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(3) *This corresponds roughly to no significant impairment of the error rate.*

Therefore, the first problem to solve in multilevel transmission consists in deciding in which way multilevel modulation is to be performed. Substantially we can distinguish two ways: the first is accomplished by exciting a laser diode by different values of current, the second is accomplished by combining the outputs of several laser diodes.

The latter way is illustrated in fig. 10 where the digital signal enters a coder driving the laser diodes whose outputs are partially taken up by optical fibres converging into a single output fibre. The beam splitters perform the automatic output control. This scheme has two advantages: it gives easily stabilized output levels and a maximum output level N-1 times the output of a single laser, where N is the number of levels.

Performance evaluation has been carried out in this case assuming that the transmitted symbols take the values $\alpha_1 \ldots \alpha_L$ with equal probabilities. A uniform spacing of the transmitted levels has been considered. Muoi and Hullett [32] have shown that this corresponds to a non-optimal choice of level placement in the presence of noise due to photodetection and avalanche multiplication, which is signal dependent. In our experience, however, non-uniform level spacing, which is a difficult operational mode to reach and maintain in optical sources, does not practically yield a relevant performance improvement in comparison to uniform spacing. On the contrary, receiver performance has shown a strong dependence on threshold positioning, so that a routine for the optimum placement of slicing levels in the decision device has been devised.

As regards nonlinear equalizers the calculation of error probability can be carried out extending the method illustrated in [10] to multilevel signals. This extension is relatively easy and is not indicated here. The number of significant interfering samples has been conveniently limited.

The results of these calculations are reported in fig. 6, 7 and 8 which show that the use of DF for multilevel signals in not so suitable as it is for binary signals, because of the precursor interference, that is very strong in multilevel signalling at high bit rates. A filter can be inserted at the input to reduce the interfering samples, according to the nonlinear operation approach already considered for binary signalling. For multilevel signal, however, the precursor interference has a much greater negative effect on the error probability. In the case of the DFE-SF equalizer, it should be noted that the increase of the precursor interference can be eliminated simply by increasing the number of the cells of the NLE, thus obtaining practically the same error probability given by the binary signals. For example for four level signals the number of cells which is necessary for obtaining a 10^{-9} error probability has to be approximately doubled. Also in this case, at not very high bit rates, the use of a shaping filter is not required using a suitable Butterworth filter.

We can therefore conclude that also for multilevel signals the DFF-SF gives by far the best performance, making it possible to operate at symbol rates twice the Nyquist rate corresponding to the leading edge of the received pulses.

7. WAVELENGTH DIVISION MULTIPLEXING

According to (1), the simultaneous use of several optical carriers via wavelength division multiplexing [33, 34] (WDM) is a viable way to increase the potentiality of optical fibre transmission systems. Multiplexing is accomplished by combining to a single fibre the optical power of several sources of different wavelengths, each modulated by a different electrical signal. At the fibre output the data streams are separated according to optical carrier wavelength and focused onto photodetectors to be re-converted to electrical signals. Imperfect realization of multiplexing-demultiplexing optics and instabilities in the source wavelengths have been shown to give rise to nonuniform insertion losses for different WDM channels and to interchannel interference, [35]. A fairly large gain margin relative to the average fibre loss may counterbalance insertion losses. However, even in the presence of ideal multiplexing-demultiplexing units, crosstalk-free operation is not attainable due to the finite spectral width of optical which represents the ultimate limitation of WDM.

The effect of crosstalk on the performance of a single digital channel in a WDM scheme can be evaluated with reference to the analytical model introduced in section 4. Eqs. (3) - (11) must be modified in the general form:

$$\lambda(t) = \frac{\eta}{h\nu} \left\{ \sum_{i=-\infty}^{+\infty} a_i \cdot h_p\,(t-iT) + \sum_j b_j \left[\sum_{l=-\infty}^{+\infty} a_{lj} h_{pj}\,(t-l\,T_j-\theta_j) \right] \right\} + \lambda_0 \tag{12}$$

to take into account the influence of optical interference from the adjacent channels. Each of the $N_p - 1$ terms in square brackets in (12) represents the crosstalk contribution of the j-th interfering channel, at level b_j. Signalling in the j-th interfering channel occurs with rate $1/T_j$ bit/s, with a relative time delay θ_j. The fibre response to the basic pulse emitted by the j-th interfering source is designated by $h_{pj}(t)$.

Computations have been carried out with reference to synchronous signalling in all channels ($T_j = T \forall_j$), assuming that only the nearest channels are responsible for interchannel interference. Thus only one or two crosstalk terms must be included in (12). Wavelength spacing has ben supposed to be close enough so that $b_{pj}(t) = b_p(t) \forall_j$. Computations performed with reference to binary signalling in the presence of a linear equalizing scheme have shown that interchannel interference has no significant influence on error rate when the crosstalk level (4) ($b_j a_{ij}$) is maintained below a threshold level (-9 to -12 dB) which is practically independent of the thermal noise level in the optical signal/thermal noise power ratio range of interest.

For higher values of $b_j a_{ij}$ a catastrophic damage of performance is shown to result, with a strong dependence on the relative time delay of the interfering channels (θ_j).

Thus the performance impairment, resulting in a higher signal to noise ratio required at the receiver input to obtain a given error rate, may be reduced by controlling the relative time delays of data streams.

A realistic appraisal of the influence of grouping several optical channels in a WDM scheme may be derived by establishing a direct relationship between the signal-to-noise ratio penalty generated by crosstalk and the minimum allowable wavelength spacing among adjacent light sources. In fig. 11 the penalty factor (in dB) is portrayed against wavelength spacing for different values of the source spectral width, assuming a simple analytical model of the source spectra in the form of a Lorentzian function.

In fig. 12 the signal-to-noise penalty is converted to a reduction of the maximum repeaterless transmission range (fig. 6-8), plotted versus the maximum number of WDM channels that can be located in a 50 nm portion of the optical spectrum, for different values of the source spectral width.

The value of 50 nm has been chosen as a reference unit roughly corresponding to the width of one of the attenuation minima of monomode silica fibres [8].

The curves of fig. 11 and fig. 12, derived for signalling, at 3 Gbit/s, have been experimented with to be largely independent of the received optical power level and of the symbol rate of the system, as far as moderately dispersed pulses are fed into the decision device.

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(4) *Reference is made to a "single interferer" model, which proved to be a sort of "worst case bound" of performance impairment.*

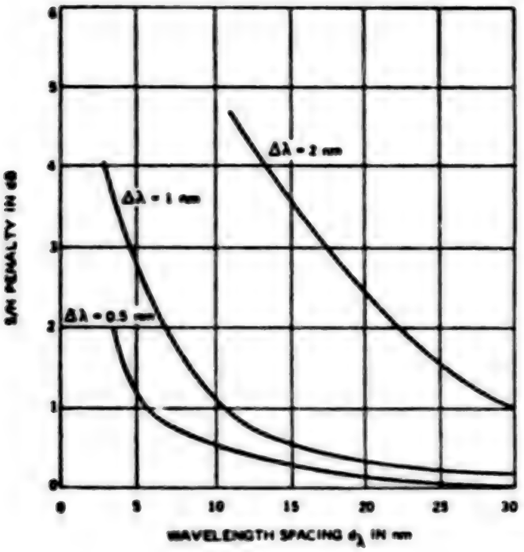

Fig.11 - Penalty factor vs. source wavelength spacing for different values of source spectral width Δλ.

8. CONCLUSIONS

The main results of a study on the maximum capacity of optical fibre links have been summarised, indicating that the use of optical fibres and of optical components already available at present may reasonably lead in the future to the introduction of transmission systems with exceptional characteristics.

Sophisticated equalization structures, multilevel line signalling and wavelength division multiplexing grouping schemes have been considered. These have been shown to be suitable means for the transmission over non repeatered spans of 40 km or more of information rates corresponding to tens of millions of digital telephone channels.

These results show the amazing capacity of an all-glass digital transmission network. It should be pointed out, however, that the full exploitation of these enormous capabilities may depend heavily on the availability of ultra fast semiconductor circuits of the type already under development, as shown in [36].

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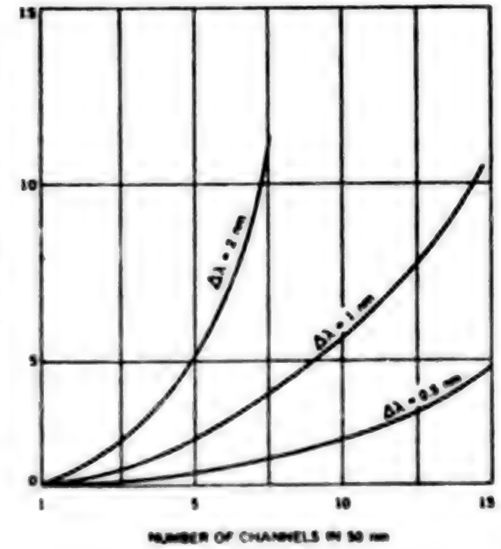

Fig.12 - Reduction of the maximum repeaterless transmission range vs. number of WDM channels in 50 nm. (Binary signalling LE - 3 GHz). Δλ = source spectral width.

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